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ANNALS of the
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VOLUME XXIII

MARCH, 1933

No. 1

*Centrifugal and Centripetal Forces in
Urban Geography*

CHARLES C. COLBY

The modern city is a dynamic organism constantly in process of evolution. This evolution involves both a modification of long-established functions and the addition of new functions. Such functional developments call for new functional forms, for modification of forms previously established, and for extensions of, and realignments of, the urban pattern. Apparently these developments of function, form, and pattern are governed by a definite although as yet imperfectly recognized set of forces. Among these forces, two groups stand out prominently. The first group is made up of the centrifugal forces which impel functions to migrate from the central zone of a city towards, or actually to or beyond, its periphery, while the second includes powerful centripetal forces which hold certain functions in the central zone, and attract others to it. For some years the writer has compiled and tabulated examples of these movements for the purpose of recognizing and classifying the forces responsible for them. This study led to the conclusion that the centrifugal forces are made up of a combination of uprooting impulses in the central zone and attractive qualities of the periphery, while the centripetal forces focus on the central zone and make that zone the center of gravity for the entire urbanized area.

In large measure, the evidence which underlies the conclusion just stated is drawn from three sources: (1) the theses, dissertations and other urban studies in geography which have been made at the University of Chicago, (2) the monographs issued by the

Committee on Regional Plan of New York and Environs, and (3) the field notes of the writer, particularly those for the season of 1924 when he was working on urban problems under a grant from the University. The survey involves studies of twenty-two cities; fifteen in the United States, four in Canada, and three in Great Britain. The method employed is distinctly that of reconnaissance, for an attempt is made to think through the problem before all of the available evidence has been examined. The conclusions, therefore, are extremely tentative, and, like the old railway time tables, subject to change without notice.

In compiling and classifying the evidence, it was found advisable to recognize three divisions of an urban area, namely, an inner or nuclear zone, a second or middle zone, and an outer or peripheral zone. Such zonal divisions are recognized by many geographers and are employed in such notable urban studies as the recent economic and industrial survey of Metropolitan New York. In the present study the recognition of zones not only aided the discovery of the individual impulses at work but facilitated the classification of these impulses into the centrifugal and centripetal forces.

That urban functions migrate from one zone of a city to another and from one part to another part of the same zone is attested by nearly all the urban studies consulted. In the present study, however, intra-zonal movements were ruled out in order to eliminate certain variables and to reduce the dimensions of the investigation. (Nearly all the urban areas investigated show striking illustrations of both centrifugal and centripetal migrations.) Outward migration of residential and manufactural functions, for example, has featured the recent growth of most American cities, and rail classification yards and warehouse facilities likewise have moved outward in many places. In Los Angeles a striking example of outward migration is furnished by the movement of the Los Angeles division of the state university first from the inner to the middle zone and more recently to the outer zone. The motion picture studios likewise have moved outward. Inward movements in our cities are evidenced by the erection of multi-storied apartment houses in or near the central zone, by the localization of "head offices" of many companies in that zone and by trends in certain lines of retailing. A classical illustration of centripetal movement is offered by the gradual concentration of the commercial phases of the Lancaster cotton manufacturing

industry in the inner zone of the Manchester area.¹

CENTRIFUGAL MOVEMENTS AND FORCES

Movements by Zones.—The centrifugal movements are in evidence in all parts of an urban area. The central zone of a rapidly growing city always or nearly always shows evidences of expansion. The "Loop District" of Chicago, for example, is expanding eastward into the lake, northward across the river, westward across the South Branch, and by a realignment of the railway terminals which now bound it on the south it promises to expand in that direction. It also is expanding upward with its towers, and promises to expand downward with a subway. This expansion is occasioned both by the overflow of certain functions from the inner zone and by the concentration of other functions in the inner zone. Both centrifugal and centripetal forces, therefore, are at work, but at the outset our concern is with the former.

In the second or middle zone of a city the centrifugal activities may be of two types. In many cases a movement may originate in zone two, and carry outward to the periphery. In other cases, a migratory tendency in the second zone may further an outward movement which originated in the central zone.² In such cases, the impulse given in the second zone resembles that of a pumping station of a pipe-line, giving fresh impetus to a flow already under way. There is abundant evidence, for example, to show that functions, displaced on Manhattan Island because of congestion, rising land values, or other causes, have moved to Brooklyn or Jersey City, only to be removed at some later date to Elizabeth, Newark, or even a more distant part of the metropolitan area.

The outer zones of many American cities have been characterized by rapid growth in the last two or three decades. Such growth has involved many types of activity but has been conspicuous in connection with the manufactural, residential and recreational functions. In some cases the growth represents functional expansion or migration from the inner zones of the urban area, in other cases it represents migration to the outer zone of a city of functions previously localized in some section of the region

¹*Manchester At Work*, Manchester Civic Week Committee (Manchester, 1929), pp. 13-14, 20-21.

²Similar types of centripetal activity also occur in the second zone, i.e., movements originating in the second zone and continuing to the inner zone, and tendencies in the second zone which give fresh impetus to inward movements originating in the outer zone.

immediately tributary to the city, while in still others it represents the establishment in the outer zone of a function entirely new to the city and to the region. Only the first named type falls within the scope of this study. Material dealing with migrations to the peripheral zone is larger in quantity and more satisfactory in quality than for the other types of urban movement which fall within the scope of this investigation. This probably is due to (1) the recency of occurrence of many migrations to the peripheral zone, (2) the size of the resultant forms, and (3) the conspicuous developments in the urban pattern when such invasions occur.

As has been stated earlier, the evidence in hand leads to the conclusion that the centrifugal forces which actually result in functional migration are the resultant of two components, namely, an urge to leave and an invitation to come. These forces, therefore, involve both uprooting tendencies in the central zone and attractive qualities in the outer zones. A confusing element in the study grows out of the fact that an outer zone with attractive qualities soon becomes urbanized—the periphery seems to be constantly or at least aperiodically in retreat. In dealing with such dynamic conditions the time element therefore always should be kept in mind.

Uprooting Conditions in the Central Zone.—Many conditions within the central zone encourage the migration of functions from the center to the outlying parts of the urban area. In the cases thus far examined six of these conditions stand out prominently. The first is the ever-increasing land and property values and the high tax rates in the central zone. Such values and rates add materially to the cost of operation and constitute ever-recurring reasons for migration unless over-balanced by other conditions. The second is the traffic congestion and high cost of transportation in the central zone. The former hampers deliveries of merchandise and the movements of people, while the latter adds to cost of operation. As a result an impulse towards migration is created for all functions except those making effective use of the costly transportation facilities and services of the central zone. The third migratory condition is the difficulty of securing space, not only to permit expansion of facilities and rearrangement of activities, but to secure light and air. The fourth is the desire of many manufacturing concerns to avoid nuisance complaints or other controversies with other city interests. The fifth is the

difficulty, or perhaps impossibility, of acquiring in the congested central zone a special type of site such as water frontage, or of modifying a site to meet present-day needs. The sixth of the conditions promoting migration includes such items as irksome legal restrictions, out-grown laws, inherited customs, decline of the social importance of certain areas, and the like.

The conditions promoting migration from the central urban zone are illustrated concretely by the trend of the metal manufacturing industries in Metropolitan New York. In recent decades, the heavy and bulky branches of the metal industries have been in process of migration from Manhattan in the central section of the metropolitan area to sites in Queens, New Jersey, and Connecticut in the outlying sections.³ The southern half of Manhattan, for example, now has less than half the number of heavy metal workers that it had in 1900, and only 5 remain of the 65 foundries in operation on Manhattan Island in 1900. The migration of these heavy metal industries grows out of their need of space on the one hand, and out of rising land values on the other. Such plants can not use high-priced land effectively, for in many cases their type of operation calls for horizontal rather than vertical space, and the vibration and weight of their machinery discourages the use of high buildings. Their noise and dirt encourages complaints from near-by property owners and in many cases they need dumpage space in which to dispose of their refuse and dirt. These industries, moreover, do not take much profit out of contact with the types of transportation available in the central zone, while they do find in the outer zone the types of rail, truck, and in some cases the water transportation suited to their needs. The same centrifugal tendency is at work in both the chemical and wood-working industries in Metropolitan New York,⁴ and Frank Williams finds it in Philadelphia.⁵ He shows how the Baldwin Locomotive Works, formerly in the heart of Philadelphia, moved out to Eddystone in the outer zone. The move was based on the uprooting conditions of expensive land, high taxes, congestion, and ineffective transportation of the old site, and the attraction of cheaper

³Lanfear, V. W.: *The Metal Industry in New York and Its Environs, Regional Plan of New York and Its Environs, Economic Series, No. 2* (New York, 1924), pp. 24-26.

⁴*Regional Plan of New York and Its Environs, Economic Series, No. 1*, pp. 21-23; No. 4, pp. 30-31.

⁵Williams, F. E.: *Suburban Industrial Development of Philadelphia: Delaware County, Bull. Geogr. Soc. Phila., Vol. XXV, No. 3, p. 37.*

land, lower taxes, freedom from congestion and effective transportation of the new.

Rapidly increasing congestion and other uprooting conditions in the inner zones of cities affect the residential as well as the manufactural and commercial functions. Well-known examples are Woodward Avenue in Detroit and Euclid Avenue in Cleveland—streets long famous for their beauty. Both of these streets have been transformed since the turn of the century. The transformation began by the invasion of the central-zone end of the avenues by smart shops and professional offices. Later other shops and many automobile salesrooms entered the districts, the residential value of the streets rapidly declined, and the residents moved to the outer zones of the area.

In some cities, the outward movement has been progressive, one wave following another. Chicago offers many illustrations of such mobility in its residential sections. In the old days, for example, the Park Row area now occupied by the Illinois Central Station was the exclusive residential district of the south side. Later this district expanded outward along Michigan, Prairie, and contiguous streets, and still later expanded outward to the Grand Boulevard area. In time an outward migration of light manufacturing and ancillary business infringed on the inner part of the area, and thereby put the wealthy people into a receptive mood for migration. This condition combined with other conditions, such as the attractive terrain and fashionable qualities of the "Gold Coast" on the north side, resulted in a considerable migration from the south side to that district. For a time the outer parts of the Michigan and Prairie avenue sections and the Grand Boulevard area were occupied by less fashionable elements, but eventually they were engulfed by an intra-zonal movement, namely, an eastward expansion of the colored district. A determined but losing fight has been waged against this invasion—the momentum of colored expansion, however, overcoming without much difficulty the resistance of an area depleted of many of its leading citizens. Those who remained did so largely because of sentiment and inertia, and in a conflict of momentum versus inertia the odds favor the former.⁶

⁶The expansion of the colored district may extend eastward clear to the lake shore. At present (1932) this appears less likely than formerly, for the electrification of the Illinois Central, the construction of the Outer Drive, and a protective organization of property owners have greatly enhanced the residential desirability of the shore district. Thus the forces of occupance wage war for desirable territory.

Attractive Qualities of the Peripheral Zone.—The centrifugal tendencies growing out of the uprooting factors in the central zone are intensified by the attractive qualities of the outer zones. In fact, as the previous paragraph demonstrates, it is difficult to think of the one without thinking of the other.

The conditions which attract functions to the periphery of urban areas are numerous and varied. Making allowance for differences in terminology and disregarding the doubtful cases in the materials in hand, the attractive qualities of the peripheral zone may be grouped into four classes. The first is the presence of large parcels of unoccupied land which can be obtained at relatively low cost. Here space, low evaluation, and low tax rates stand in direct opposition to congestion, high evaluation, and high taxes in the central zone. The second is the presence of transportation services suited to the migrating function. In some cases, these services may be circumferential; in others they may be axial, thus giving certain parts of the outer zone direct transportation to the inner zone. A position on a belt line, for example, attracts manufacturing concerns because it puts them into effective contact with all the railways entering a city, while ample space and facilities in the plants and yards reduce the cost of loading and unloading. A position in the outer zone where streets and highways are less congested, moreover, may facilitate the use of trucks. A residential development, in contrast, finds little or no interest in circumferential transportation, but is vitally dependent upon rapid axial transportation of the type well illustrated by the electrified Illinois Central in Metropolitan Chicago. The third group of peripheral attractions includes the attractive site qualities possessed by particular areas in the outer zone, such as level land, good drainage, wooded slopes or water frontage. The fourth is control or relative control of a sizeable area. Such control, in the case of the residential function, makes it possible to have freedom from smoke, noise, or other nuisances, and the privilege of imposing regulations as to the type of occupancy. For the manufacturing function, it means freedom to lay out and to operate the plant, to dispose of waste, to develop a particular type of community, and, in short, to proceed in a manner conducive to the success of the enterprise.

The attractive qualities of the peripheral zone, particularly of large areas of cheap land and adequate transportation, are well illustrated in the development of the East St. Louis sector of

Metropolitan St. Louis. Development of this sector was delayed because it was subject to the floods of the Mississippi. When once a levee was built and part of the area drained, the drained areas became attractive to large-scale manufacturing industries of the basic or heavy type, and in large measure the land has been occupied by establishments of this type. Some of these establishments formerly were in St. Louis proper, some are branches of earlier developments in St. Louis, while still others chose a site in East St. Louis in preference to a site nearer the center of the metropolitan area. Thomas points out that of the eighty heavy manufacturing establishments in the metropolitan area in 1924, sixty-five are in East St. Louis.⁷ Twenty lines of railway enter the city from the east and these are connected by three transfer lines. As might be inferred, a large number of sites, combining cheap land and efficient rail transport, are available. These east side sites offer the further advantages of dumpage space in the sloughs and ponds which dot the plain and a supply of water derived either from the river or from wells "sunk at relatively low cost in the alluvium of the American Bottoms." The east side sites also offer manufacturers the advantage of receiving coal from the Illinois coal fields without having to pay toll charges across the Mississippi as they would if their plants were on the west side. The east side concerns, moreover, are able to ship their output to eastern markets without paying bridge charges.

The attraction of a particular site quality is well illustrated by the evolution of sugar refining in Metropolitan New York. Sugar refining in the city began as early as 1730. The early refineries were located on Manhattan Island but were not on the waterfront. In 1858 a plant was located on the waterfront in Brooklyn in order that it might receive raw sugar directly from the vessels. The advantage of a waterfront site soon was demonstrated, and sugar refining on sites back from the waterfront became a thing of the past. By 1900 decentralization had gone to the point where the plants on Manhattan had been replaced by three plants in Brooklyn, one in Queens, and one in Jersey City. By 1922, there were two in Brooklyn and one in Queens, while at a considerable

⁷Thomas, Lewis F.: *The Localization of Business Activities in Metropolitan St. Louis*, Washington University Studies—New Series, Social and Philosophical Sciences, No. 1 (St. Louis, 1927), pp. 79-82. (Dissertation in geography at the University of Chicago.)

distance up the Hudson a plant had been built at Edgewater and two in Yonkers. This suggests that the tendency to move further from the central zone is still in operation.⁸

The development of the iron and steel industry in the Chicago area strikingly illustrates both the uprooting tendencies of the inner zone and the attractive qualities of the outer zone, or, in reality, of the components of the centrifugal forces. In the Chicago area iron manufacture first developed along the Chicago River near the center of the city. The industry appeared as early as 1839, a blast furnace was built in 1868, and by 1876 Chicago produced almost a third of the steel rails of the country. In 1880 a new mill was built in South Chicago. The erection of this mill was concrete evidence of the operation of centrifugal forces. After 1880 production declined on the Chicago River and at present no steel is smelted in that section of the city. Production in South Chicago, however, increased rapidly, and later came the great development in Indiana Harbor and Gary. In an analysis of the migration of this industry, John Appleton emphasizes the attractive qualities of the outlying areas, his list including (1) large parcels of unoccupied land available at low prices not only for steel mills, but for the auxiliary fabricating plants which utilize much of the output of the steel mills, (2) lake front or river locations, (3) the sandy character of the lake plain which made dredging and excavation for slips a simple engineering task, (4) an abundance of water, (5) marsh or lake areas for dumpage of waste materials, (6) freedom of use, in that control of the land made it practicable to perfect economies of plant layout and operation, and to organize or to permit others to organize, the contiguous areas for residential and other purposes, (7) adequate transportation facilities for assembling raw materials and distributing the output, these facilities resulting from a combination of lake transportation and belt line contact with all railroads entering Chicago, and (8) proximity to the Chicago reservoir of labor.⁹

⁸Williams, Faith M.: *The Food Manufacturing Industries in New York and Its Environs, Regional Plan of New York and Its Environs, Economic Series, No. 3*, pp. 15-20.

⁹Appleton, John B.: *The Iron and Steel Industry of the Calumet District*. University of Illinois Studies in the Social Sciences, XIII, No. 2 (Urbana, 1927), pp. 15-16, 27-28, 81-91. (Dissertation in geography at the University of Chicago.)

Appleton, being concerned primarily with the Calumet area, did not emphasize the uprooting conditions along the Chicago River. In all probability, these included the rising value of land in the central zone, the need of room for plant expansion, the numerous bridges and other features which hinder navigation on the Chicago River, and the absence of ready contact with all the railways entering the city. Probably the fact that the steel companies could dispose advantageously of their sites along the Chicago River was another factor.

Centrifugal Forces.—As has been stated previously, the evidence in hand leads to the conclusion that the centrifugal forces are made up of a merging of impulses, namely, a desire to leave one part of the urban area and an urge to go to another. If this is sound it appears logical to assume that the forces are made up of impulses promoting migration and that these impulses reflect the cultural-natural complex in one or more of the urban zones. It also may be assumed that the forces, to a degree, have a beginning and an end and that in logical classification the beginning and the end should be of the same kind or quality. Certainly, the material thus far surveyed substantiates the last contention, for the uprooting impulses on the one hand and the locative attractions on the other fall into satisfactory alignments. Without undue manipulation of variables, therefore, the following six forces are recognized: (1) the *spacial force*, under which congestion in the central zone uproots and the vacant spaces of the outer zones attract; (2) the *site force*, under which the greatly modified and intensively utilized natural landscape of the central zone is balanced against the relatively unchanged and but little used natural landscape of the periphery; (3) the *situational force* which arises from unsatisfactory functional spacing and alignments in the central zone and the promise of more satisfactory functional spacing and alignments in the periphery; (4) the *force of social evaluation*, under which such conditions as high land values, high taxes, and inhibitions growing out of the tyranny of the past in the long-established central zone create the urge to move, and low values, low taxes, and freedom from restrictions imposed by previous occupancy in the newly developing periphery represent the invitation to come; (5) the *status and organization of occupancy* in which such things as the obsolete functional-forms, the crystallized pattern, the traffic congestion, and the unsatisfactory transportational facilities of the central zone in many instances

stand in opposition to the modern forms, the dynamic pattern, the freedom from traffic congestion, and the highly satisfactory transportation facilities in the outer zone; and (6) the *human equation*, which includes such potent migratory impulses as arise from religious tenets, personal whims, real estate booms, manipulated politics and the like. It is thought that this last category is sufficiently vague and sufficiently comprehensive to care for all items which elude classification under other heads.

CENTRIPETAL FORCES

The centripetal forces in urban development focus on the central zone of the city and, as previously stated, the central zone is the center of gravity of the entire metropolitan area. In this zone the number and complexity of urban functions increases greatly. Functional congestion necessitates complex functional forms and frequent adjustments in the zonal pattern. The urban cross-section in the central zone of our larger cities, moreover, is made up of multiple levels extending from the bottom of the lowest basements to the top of the tallest towers. Land values in such areas are high, in harmony with the intensive use of the land. Such intensive use indicates that the central zone possesses assets or qualities which make it highly attractive to many functions. The data already compiled include more than forty different types of these gravitative qualities. Differences in terminology, however, account for many of the types and thus if certain cases which at present elude classification are disregarded the attractive qualities may be classified into the following five groups:

1. Site attraction,
2. Functional convenience,
3. Functional magnetism,
4. Functional prestige, and
5. The human equation.

These five groups comprise the gravitative attributes of the central zone and are *per se* the centripetal forces of the urban area.

Site Attraction.—In each of the cities under study some feature of the natural landscape, inconspicuous as it may be in the present urban complex, invited occupance. In London it was a crossing of the Thames, in New York it was the accessible waterfront of the lower end of Manhattan Island, in Montreal it was a short stretch of quiet water protected by a tiny peninsula, while in St.

Louis it was "the river end of a long, narrow upland spur" which Thomas calls "Downtown Upland." In many cases the attractive quality of such features has continued unabated to the present. Thus, for example, while the commercial functions established on the lower end of Manhattan have developed enormously, they never have been dislodged from the site selected by the Dutch for their trading activities. Much the same has been true of the other cities studied.

Functional Convenience.—Many functions remain in or gravitate to the central zone of the urban area, because in that zone they can be carried on more conveniently than elsewhere. In many cases this functional convenience endows the central zone with such active qualities that it takes on a more diverse character and a more rapid tempo than the outer zones. For purposes of classification this all-important quality of convenience may be divided into three types or classes.

The first type of functional convenience possessed by the central zone is *metropolitan* (i.e. local) *convenience*, and results from the fact that the central zone is the focal point not only for the main thoroughfares in the urban pattern, but for all systems of rapid transit. Thus the fact that the central zone is the major focus of city transportation makes it the one place where the retail business, for example, conveniently can reach customers in all parts of the metropolitan area, and, conversely, where all the potential customers conveniently can reach the stores and shops. In order, therefore, for a retail establishment to be convenient to patrons in all parts of the city, it must be within the focal area. In retailing, the world will beat a path to your door only if and when your door lies conveniently near the world's daily runway.

The second type of functional convenience possessed by the central zone is the *regional convenience* arising from the fact that the railways of the region dominated by the city converge on the central zone and have concentrated their passenger, mail, and express terminals in that zone. In recent years this type of convenience has been accentuated greatly by the convergence of arterial highways on the central zone. These railways and highways make the central zone accessible to the region which the city dominates and to a marked degree make that zone the point of convergence and the point of convenience for the whole area. Indianapolis, with its marked regional dominance and with many railways and highways focusing on its central zone, well illustrates

this type of convenience. Furthermore, one only needs to recall the railway terminals which cluster about the central zones of London, Berlin, Paris, and Chicago, and the highway patterns about those cities, to realize the validity of the generalization.

The third type of functional convenience possessed by the central zone is *inter-regional convenience* and grows out of the fact that many cities are focal points for two or more regions. This type of convenience is highly developed in the great commercial centers; in fact, they could not be great commercial centers if they did not possess it. In New York, London and Liverpool, for example, most of the commercial port¹⁰ is included in the central zone. In Liverpool, in fact, the landing stage where the ocean liners load and discharge passengers, mail and express is oriented so effectively into the local transportation services that an arriving passenger can go promptly to any point in the central zone, to most points in the metropolitan area, and to most parts of Great Britain. The presence of the commercial port acts as a centripetal force attracting shipping offices, importing and exporting houses and the like into the central zone. Such establishments add to the complexity of the central zone, and emphasize its focal quality. In the central zone of any of these cities one sees evidences of contact with many countries and finds available transportation services to practically all parts of the Commercial World.

All three types of functional convenience are well illustrated by the clothing industry of New York City. This city has attained national leadership in the industry and commonly produces more than 70 per cent of the women's clothing and more than 40 per cent of the men's clothing manufactured in the United States.¹¹ The industry, however, is highly localized in the metropolitan area, for most of it is carried on in the central zone, i.e. in Manhattan south of 59th Street. The retail phase of the industry is localized in the central retail district, a district emphasized in the city's profile by the number and height of its skyscrapers. This district extends from about 34th Street to 58th Street and possesses great metropolitan convenience, for it is the area on which the transportation of the metropolitan area converges. On the south, the retail district is bordered by wholesale clothing,

¹⁰As used here the commercial port is distinguished from the industrial port.

¹¹Selekman, B. M., Walter, H. R., and Couper, W. J.: "The Clothing and Textile Industries in New York and Environs," *Regional Plan of New York and Its Environs, Economic Series, Numbers, 7, 8, and 9*, pp. 16-17, 50, 65-77.

haberdashery, jewelry and fur houses. The turn-over of modern retailing is so rapid that the jobbers must be near the retailers in order to make frequent deliveries to the stores and shops. From the same sites, moreover, the jobbers can make rapid deliveries via the rapid transit lines to retailers in Newark, Brooklyn and other sub-centers within the metropolitan area and thus, like the clothing retailers, enjoy metropolitan convenience. From these same sites in the central zone the jobbers also take the benefit of regional and inter-regional convenience by frequent shipments by rail to their customers in other parts of the Eastern Seaboard region¹² and to practically all sections of the country. Conversely, buyers from all parts of the country find satisfactory railway service to New York; and arriving at the Manhattan passenger terminals find it only a short walk from their hotels, placed conveniently near the terminals, to the streets which contain the small retail shops and to the display rooms of the jobbers.

Functional Magnetism.—The concentration of one function in the central zone operates as a powerful magnet attracting other functions. Thus on Manhattan the wholesale phases of the clothing industry attract the manufacturing phases. The jobbers are the dictators and designers of fashion, and for convenience of performance the wholesale areas are fringed by factories and shops where the clothing and allied lines are manufactured.¹³ In many cases, a profile of a building in the wholesale area shows display rooms on the street floor, offices of jobbers on the lower floors, and the manufacturing phase of the industry on the upper floors. These lines of industry require an enormous labor force, a force up to now recruited, in large measure, from European emigrants landed conveniently near in the commercial port.¹⁴ Convenience to the shops and factories encourages these people to live in the congested east side of Lower Manhattan. Thus the residence function also is held in the congested central zone.

The attraction exerted by a cluster of functional units on other units of the same type represents another type of functional magnetism. Hurd, writing in 1902, advanced the theory that within the retail district there is a tendency for shops of the same type to cluster together, in spite of the fact that they do little or no

¹²As used here, Eastern Seaboard applies to the area from Boston to Washington, inclusive. This is the sea frontage of the trunk line territory.

¹³*Ibid.*, pp. 52, 65.

¹⁴*Ibid.*, p. 57.

business with each other.¹⁵ He argued that the force which invites such clustering of functional units is the desire to insure customers against failure to find what they want. Although Hurd himself offers no evidence in support of his theory, recent urban studies do much to substantiate it. The Fifth Avenue section in New York City¹⁶ and the central zone of Paris both show remarkable clustering of art, jewelry, and other high class shops, and most large cities show examples in kind. The same magnetic quality betrays itself in the distribution of theatres and motion picture houses in New York and Chicago, and it appears in the distribution of parking spaces, garages, professional offices and many other functional forms. In many cases the clustered functional units gain a momentum which distinguishes them from competitors outside of the cluster.

The central zone of Metropolitan St. Louis or "Downtown St. Louis" offers a remarkable illustration of the three centripetal forces thus far discussed, namely, site attraction, functional convenience, and functional magnetism. This zone contains the principal wholesale, light manufacturing and retail industries of St. Louis. The wholesale and jobbing section of the zone fronts the Mississippi River and extends westward up a small tributary valley.¹⁷ This section served as a fur-trading post as early as 1764, and through all the vicissitudes of changing transportation the site attraction of the section has been so great that it has remained the principal commercial section of the city. During steamboat days it was the most accessible part of the waterfront. When railway transportation developed, no other section of the city was as convenient to the bridges and terminals, while with the advent of the motor truck this section found itself at the intersection of the principal arterial thoroughfares. Such allegiance to site grows out of the power of central position, accentuated by a remarkable development of the transportation functions.

From time to time during the progress of the nineteenth century, St. Louis developed additional manufacturing activities. In

¹⁵Hurd, R. M.: *Principles of City Land Values* (New York, The Record and Guide, 1911, 3d ed.).

¹⁶Davenport, D. H., Orton, L. M., and Roby, R. W.: *The Retail, Shopping and Financial Districts in New York and Its Environs, Regional Plan of New York and Its Environs, Economic Series, Numbers 10 and 12*, pp. 20-21.

¹⁷Thomas, *op. cit.*, pp. 44-48.

this development the lighter types of manufacturing became localized in or contiguous to the wholesale and jobbing section. In fact, many of the manufactural enterprises were started by firms already engaged in some phase of the wholesale trade. Thomas names boots and shoes, clothing, tobacco and fourteen other industries as developing out of wholesale activities in the same lines. In many cases the jobbing and manufacturing activities of a firm are in the same building. Here then is functional convenience and magnetism carried to the extreme. Interestingly enough, rising land values in the wholesale section and attractive manufactural sites in the northwestern section of the city have led to the location of some of the newer light manufacturing plants in the metropolitan periphery. Such developments represent a conflict between centripetal and centrifugal forces in which the former, in this case at least, are more powerful than the latter.

Functional Prestige.—Functional prestige is a centripetal force of no mean importance, although the literature thus far examined contains but scant evidence bearing on the point. The Rue de la Paix in Paris furnishes an excellent example. That short street is the center of the fashion world, and a position on it along with such world renowned firms as Worth, Paquin, and Armand, in itself does much to raise a firm to a rank of importance. Savile Row in London bears much the same relation in men's fashions, while certain sections of Fifth Avenue in New York, Michigan Avenue in Chicago, and, in fact, certain blocks in almost every city carry a greater or less degree of prestige. Commonly, the origin and continuance of prestige rests on the momentum gained from a combination of functional convenience and functional magnetism.

The inner zone of many cities contains a section in which the offices of professional men such as physicians and dentists are grouped. Their presence in the central area in large measure is a matter of transportation convenience to their patrons. Their grouping in a small area, or in a special building as in San Diego and Spokane, however, is a matter of organization in order to encourage the development of functional prestige. When once the leading professional men in a particular line are localized, that locality gains functional prestige. In time the group may rest too heavily on its prestige in which case prestige breeds inertia. In that case, the grouping may be dislodged or disintegrated, if the area is

in demand by a function in the process of expansion. The same principle probably applies to all types of clustering due to functional prestige.

The Human Equation.—The human equation acts both as a centripetal and as a centrifugal force. Choice, for example, leads some people to commute from outlying residential districts, while it leads others in similar financial circumstances to occupy apartments near the central business district. The human desire to be in the center of things probably leads to an over-estimation of the value of a location in the central zone. Sentiment and perhaps stubbornness leads some wealthy families to cling to sites in the central zone long after the residential function as a whole has moved out of the area. Civic pride and personal vanity have led to the erection of "sky-scraper" office buildings and hotels in small cities on the Texas plains. The folly of many real estate booms and of much financial promotion is attested by many unprofitable buildings in the central zones of our cities and by decadent sub-divisions on the outskirts.

Faith Williams, in a remarkable study of the food manufacturing industries of metropolitan New York, shows how a social condition affects the localization of stock yards and slaughtering houses on Manhattan Island at 60th Street.¹⁸ The stock yards and slaughter houses employ adult male workers and the seasonal factor is unimportant. This naturally suggests an outlying location. They cling tenaciously to their Manhattan site, however, because of their interest in the Kosher trade which must have freshly slaughtered meat. Here, then, is a religious custom acting as a centripetal force.

BALANCE OF FORCES

In order to recognize and describe the centrifugal and centripetal forces as sharply as possible, the method thus far has been to focus attention first on one set of forces, and then on the other. In reality these forces are continually in conflict. In some cases one set of forces is so strong that there is little or no question about the position which a function occupies or should occupy in the urban pattern. In other cases, the matter is uncertain. In still others, the forces have divided the function into two parts,

¹⁸Williams, Faith M.: *op. cit.*, pp. 20-25.

one remaining in the central zone, the other seeking a location in the periphery. The arrangement of Northern Pacific Railway yards and shops in Spokane is an example.¹⁹ Under the principle of local convenience the original yards of this railway were built near the center of the city. As business grew, the yards have been expanded as much as practicable, considering the complex city pattern and the associated high land values. The yards, moreover, were brought to high efficiency through improved equipment and effective organization. They were not adequate for the growing business, however, and the company in response to the centrifugal forces of space and site opened new yards on a large block of vacant land at Yardley on the eastern periphery of the city. Yardley lies outside of the zones in which the city requires grade elevation, in a section where the land is cheap. The valley floor is wide and less rough than in the heart of the city, and excellent gravel for road bed construction is available. These qualities made it possible for the company to develop large and highly efficient yards in the new area. The balance of centrifugal and centripetal forces also is illustrated by the division of the railway shops into an emergency shop near the passenger and freight terminals in the central zone, and large shops equipped to give complete service at Yardley in the peripheral zone.

The baking industry in Metropolitan New York is another example of an industry in which a part is attracted to the central zone by centripetal forces, while centrifugal forces tend to spread the other parts into various sections of the metropolitan area. The former is illustrated by the biscuit and cracker manufacturing division of the industry, carried on in large plants in the central zone in order to be in the focal area of the transportation services both for the city and the region. The bread, cake and pie bakeries divisions, however, are scattered through the residential districts. They need to be near their customers in order to give frequent deliveries and because their bread, cake and other finished products are more bulky and perishable than their flour, sugar and other raw materials. In the better residential districts they have to build and conduct their plants so that they will not be regarded as nuisances.²⁰

¹⁹Martin, Elizabeth: *The Railway Pattern and Facilities of Spokane, Washington*. Unpublished masters' thesis in geography, University of Chicago, 1926.

²⁰Williams, Faith M.: *op. cit.*, pp. 25-31.

STATUS OF INVESTIGATION

The conclusion of the present investigation is stated in the opening paragraph of this paper. This conclusion was reached in 1930²¹ and subsequent work tends to support it. This recent work, moreover, has strengthened the conviction that the conclusion must remain tentative until closely related problems have been investigated. Functional movements within individual urban zones must be studied, for they are so closely interwoven with the inter-zonal movements that a study of the former should throw new light on the latter. Studies of functional migration from city to country and vice versa are called for, as well as studies of the initial appearance of functions in a region and perhaps the total disappearance of other functions from the region. Each of these, and probably other studies, is inherently a part of the challenge which urban areas present to geographical investigation.

Conclusions of the type stated in this paper need to be tested by a further examination of the literature bearing on urban problems. A systematic examination now under way, for example, of English, French and German sources may reveal data which will lead to modifications of the present viewpoint. It is thought that the results of field investigations will prove even more important. No doubt a considerable amount of valuable material is contained in reports of city-planning organizations. Unfortunately, although these reports are based on local study, the material in many of them is relatively sterile from the geographic viewpoint. In many cases such studies deal with plans for ephemeral remodeling of the urban pattern in conformity with some betterment program. No doubt they have social value, but they do not deal with the fundamentals of urban development as the geographer sees it. Systematic analysis and logical synthesis are required instead of emotion. Even the superlative work revealed in the Regional Plan of New York and Its Environs leaves much to be desired in its locative and distributive aspects.

Although the geographical contribution to the study of urban problems promises to be important, it can not be made without numerous field studies in the geographical manner. Happily, there is a rising tide of interest in urban geography and impor-

²¹This paper was presented at the Worcester meeting of the Association, December 1930.

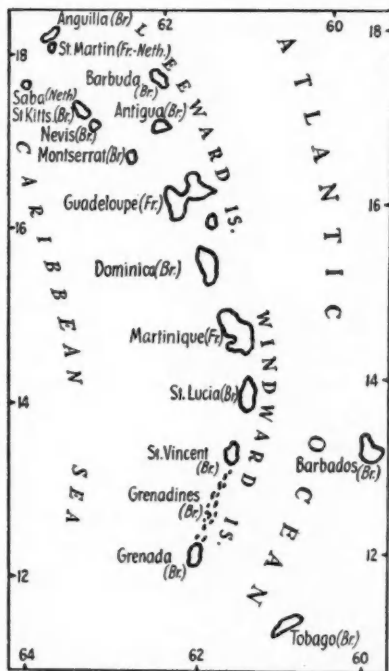
tant field studies are under way in nearly all parts of the country. Recent advances in field technique and method should insure the quantitative data needed in testing the validity of current theory and hypothesis.

The Lesser Antilles—Past and Present

R. H. WHITBECK

Upwards of 25 inhabited islands and many smaller ones constitute the island arc on the eastern border of the Caribbean. Eleven of the sizeable islands are of volcanic but not of recent origin. Most of the volcanoes are quiescent or extinct but not all. The terrible eruption of Mt. Pelee on Martinique in 1902 cost over 25,000 lives. These old volcanic mountains rise above the sea to heights exceeding 5,000 feet, and extend much further below the sea. Deeply valleyed by streams and clad in rich tropical vegetation, the mountainous islands are superbly beautiful. "Edens of Delight" Robert Hill has called them. Dominica is the most majestic of them all. The little Dutch islands of Saba and Eustatius and the small British Nevis are symmetrical volcanic cones.

Of wholly different origin and character are eight other islands forming a line east of the volcanic series. Mainly composed of limestone, these islands are of low relief, lacking in surface streams, generally cultivated and densely populated. Of this group, Barbados, with about 900 people to the square mile is the best example.



¹In his book, "Cuba and Porto Rico," p. 326-7, 1898.

Trinidad, though lying in line with the Lesser Antilles, does not belong to them, but is a detached fragment of South America and is not considered in this paper. While the inhabited British islands average under 100 square miles in area, the two French islands—Guadaloupe and Martinique—have a combined area of 1,000 square miles. Each of the larger islands has its own seat of government, always a port town, on the western coast, so placed for protection against the prevailing winds and the hurricanes. Only one island, St. Lucia (of the British group) has a good harbor and it is the chief British military and naval base in these waters. An island usually has only one town of any size and these range in population from one or two thousand up to fifteen thousand for Bridgetown in Barbados and 40,000 (Fort-de-France) in the French islands.

Most of the islands were sighted and named by Columbus, but were not settled by the Spaniards. The British gained about half of their islands by settlement in the 17th century and half by conquest later. It seems hardly possible that the European powers could ever have placed such a value upon these little islands as they did. Almost everyone of the main islands was at some time defended by fortifications of great strength. Most of these are still well preserved but have been dismantled. The powerful fortifications on St. Kitts and St. Vincent are in the class with those at Quebec.

In the frequent European wars involving Britain, France, Holland, and Spain, the Caribbean was the scene of repeated naval operations of the first order. Not a few of England's most famous sea fighters, including Nelson, gained their fame or a part of it in the West Indies. The great victory of the British fleet commanded by Rodney over the French under De Grasse in 1782 was fought in these waters. The Caribbean has been called the cradle of British sea power. In no other waters have European nations fought more doggedly for supremacy than they fought for their islands in the Caribbean. The thirteen English colonies along the Atlantic seaboard of North America were decidedly less valued than the tropical colonies of the West Indies. Huge continental areas such as Canada and Louisiana were lost seemingly with less regret than little Caribbean islands scarcely more than specks on a map.

Why were these islands so coveted, so frequently won and lost and so staunchly defended? The outstanding reason seems to have been the desire of the trading nations of Europe to control tropical, slave-buying, sugar-yielding colonies. Islands were preferred because all of their land was near the coast, their products were easily delivered to ships, and they could be defended by the navies of the respective owners. Cane, the one important source of sugar at that time, grows only in the tropics or subtropics. Sugar and its by-product—rum—were in increasing demand in Europe, and both were highly profitable articles of trade. The production of cane did not require intelligent labor. It lent itself to plantation methods and slavery. It was in many ways the preferred of all tropical crops, and islands were, and still are, the preferred locations for growing it.

ACREAGE OF PRINCIPAL CROPS IN THE BRITISH LESSER ANTILLES

Colony	Sugar Cane Acres	Cacao Acres	Coconuts Acres	Cotton Acres	Limes Acres
Barbados	35,000	.....	.....	.....	.....
Antigua	11,033	.....	560	400	620
St. Kitts-Nevis	6,883	.....	700	2,900	.....
Dominica .....	.....	.....	.....	.....	6,000
Montserrat .....	.....	.....	.....	3,200	1,000
Granada .....	.....	20,500	.....	.....	.....
St. Lucia	4,300	6,000	.....	.....	2,650
St. Vincent	1,500	1,500	.....	4,996	.....

The tropical islands most readily reached from Western Europe were the West Indies. The trade winds carried the sailing vessels to them and the southwesterlies brought them back. Caribbean islands became the Sugar Islands of the world; at times the source of abounding wealth, but oftener the seats of distressing loss and bitter complaints. During the last hundred years the losses and the complaints have predominated. The abolition of slavery and the rise in Europe of bounty-fed beet sugar brought the undoing of the sugar industry in the West Indies; and this undoing has more recently been increased by the modern methods of production used in Cuba, Puerto Rico, and the Pacific islands. While sugar is still the leading product in half of the Lesser Antilles, their combined export is relatively small.

During the past half century these distressed islanders have

sought first one form of economic relief and then another. British Royal Commissions have repeatedly been sent out from England to collect information and recommend remedies. Agricultural experiment stations have sought to find more profitable crops than sugar. At the present time Granada, St. Lucia and Tobago are specializing in cacao; Dominica is growing limes; Montserrat and Nevis are working with sea island cotton, and St. Vincent with arrowroot; but none of these efforts has been particularly successful. However, Barbados sticks to sugar, molasses and rum almost wholly. The sugar estates average 200 to 300 acres in extent and the sugar mills are relatively small.

Sugar is also the leading export of Antigua and St. Kitts, and of the French islands. On the whole, sugar cane occupies more acres than any other crop grown in the Lesser Antilles. Most of the sugar mills of the British Lesser Antilles are small and only semi-modern, although St. Kitts is served by a single large modern central fed by a light railway that encircles the island. The high tariff duty on foreign sugar imposed by the United States excludes Lesser Antillian sugar from this country, but it enters Canada and the British Isles on preferential terms. This, however, is of little aid at present ruinous prices. But even in normal times there seems to be little hope in sugar for those unfortunate islands.

The French islands are both politically and economically better off than the British. Martinique and Guadeloupe are integral parts of the French Republic and send representatives to the French parliament. Their commerce is almost wholly with France where their products receive preferred treatment. The French islands have never suffered the frequent setbacks that the British possessions have repeatedly experienced.

Another aspect of the life of these islands is their exaggerated sense of individualism obviously arising from insularity. Again and again efforts have been made to group the islands, reduce the number of separate governmental units and thus reduce the number of major officials and the high cost of government. Repeated conferences looking to fuller coöperation and even to federation have been held, but with little success. The detached, insular character of each unit, and the exaggerated idea of its importance

held by each island has led to a sense of separateness rather than of unity. Insular peoples are notoriously thus. The Isle of Man, for example, still insists upon retaining its ancient parliament, and Newfoundland, the only large inhabited island of Canada, refused to join the Dominion and remains outside. A similar attitude exists among the Lesser Antilles. The best that the mother country has been able to do is to restrict the insular colonial units in these waters to four colonial governments each having a governor sent out from England. The four are the Leeward Islands, the Windward Islands, Barbados, and Trinidad-Tobago, the last named not being included in this paper. The entire area of the first three of these governmental units is only 1400 square miles, or two average midwestern counties of the United States. The governor of each of these small colonies is expected to be a "Sir" and usually a lieutenant colonel or colonel. He lives in a spacious mansion surrounded by servants, is treated with more respect than a governor of our Empire State and is paid a salary of \$12,000 to \$20,000 a year. Each of the separate islands of the Leeward and Windward groups has its administrator or commissioner, and a sub-group of islands or even one island may constitute a presidency. Each of the colonies, and in some cases a single island, has a legislature, a chief justice, an attorney general and a whole staff of other officials. The cost of government is out of all reason. Every colony and sometimes every island in a colony has different tariffs, even tariffs against other islands belonging to the same colony. One writer says, "The islands are burdened with all the paraphernalia of a first-class European state."²

It would be difficult to find a more impressive example of narrow individualism arising, in part, at least, from an insular habitat. It has been relatively easy to unite the provinces of Canada or the states of Australia into single dominions of continental size, but the island peoples of the British Antilles refuse to be united. It is a case of insular psychology gone mad, yet when any proposal to unite these subunits or units is made it meets with determined opposition. Each island's slogan seems to be "Whom God hath put asunder let not man join together."

²Norman Lamont, *Problems of the Antilles*, p. 98, 1912.

One further observation in closing: France and Great Britain owe the United States several billions of dollars. It has been intimated that we might accept their West Indies possessions in part or full payment of those troublesome debts. Evidently most Americans are opposed to cancellation of these debts, but as between cancellation and accepting the islands please count me for cancellation.

Memoir of Albert Perry Brigham

O. E. BAKER

The Association of American Geographers has lost by death during the last year four members of that extraordinary group who organized the Association 28 years ago, and two other members elected about ten years later. This is the most severe loss in the history of the Association.

I wish to speak in commemoration of one of these charter members,—Professor Albert Perry Brigham, of Colgate University, who served the Association as secretary during the first nine years of its existence and as president during the tenth year. No member has contributed more to the welfare and progress of the Association. With reference to his work during the first decade of the Association's existence, Professor Dodge has noted that "His enthusiasm, his inventiveness, his ability to handle details all contributed to his success in bringing strength to a loosely organized group of co-workers." It is owing in large measure to his careful guidance and splendid service that this Association exists today.

In addition to his duties as Secretary for nine years, as Treasurer also for three years, and as President of the Association for one year, Professor Brigham prepared seven papers during the first decade of the Association's existence:

1904—The Development of the Great Roads Across the Appalachians

1906—Geography for College Entrance

1908—The Capacity of the United States for Production

1908—Three Gatherings of Geographic Interest

1909—An Attempt at a General Classification of Geography

1909—The Organic Side of Geography; Its Nature and Limits

This last named paper, presented at a round table meeting, marked a milestone in the development of what has come to be called human geography. Dr. Brigham's interest in this phase of geography found fuller expression in his presidential address before the Association in 1914, on the Problems of Geographic Influence. The attitude of the scientist is shown by the following

statement in this address, which has proven prophetic of the trend of geographic research in recent years:

"Our goal is broad generalization. But the formulation of general laws is difficult and the results insecure until we have a body of concrete and detailed observations. . . . Detailed investigations of single problems, in small and seemingly unimportant fields, must for a long time prepare the way for the formulation of richer and more fundamental conclusions and general principles than we have yet been able to achieve. We should not wait for someone to state or demonstrate these laws. This is yet, even for a genius, impossible. We must contribute in a partial, microscopic, sometimes unconscious way to the emergence of such laws."

But Professor Brigham's interest in the Association did not end with this valedictory address in 1914. In 1918, he contributed a paper on "Principles in the Determination of Boundaries," and in 1919 another notable paper, "Cape Cod and the Old Colony," also the Memoir of Frederick V. Emerson. Again, in 1923, he presented a very valuable historical paper, in celebration of the twentieth anniversary of the Association, entitled, "The Association of American Geographers 1903-1923," and, as a tribute to the founder of the Association on its twenty-fifth anniversary (1928) he presented "An Appreciation of William Morris Davis."

The Association of American Geographers was not the only recipient of Professor Brigham's unstinted service. From 1900, when he became Associate Editor of the *Bulletin of the American Geographical Society*, to 1930 when he represented the Society at the Centenary of the Royal Geographic Society in London, he contributed 18 articles to the *Bulletin* and its successor, the *Geographical Review*.

But of greater significance, perhaps, than these various papers which have appeared in the *ANNALS* and in the *Geographical Review*, were his textbooks and other more ambitious volumes:

1900—Textbook of Geology

1902—Introduction to Physical Geography; prepared in collaboration with G. K. Gilbert

1903—Geographic Influences in American History; a pioneer work which remains among the notable contributions to the geographic interpretation of history

1911—Commercial Geography; a college textbook

- 1916—*Essentials of Geography*; an elementary text in two volumes, prepared in collaboration with C. T. McFarlane
- 1920—*Cape Cod and the Old Colony*; a volume of geographic description possessing highest literary merit
- 1921—*A Manual for Teachers of Geography*, prepared in collaboration with Professor McFarlane
- 1927—*The United States of America—Studies in Physical, Regional, Industrial and Human Geography*; the outgrowth of a series of summer lectures at the University of London
- 1929—*The Glacial Geology and Geographic Conditions of the Lower Mohawk Valley*; a bulletin of 200 pages issued by the New York State Museum.

A complete list of Professor Brigham's published works to and including 1929, comprising 83 titles, will be found in the *ANNALS OF THE ASSOCIATION OF AMERICAN GEOGRAPHERS* for June, 1930, which was a number devoted to the celebration of his 75th birthday. In this issue of the *ANNALS* will be found seven papers, the tribute of seven friends, each a specialist in his field of labor, dealing with Professor Brigham as geologist, as physiographer, as human geographer, as popularizer of geography and geology, as geographer envoy from America to Europe, as educator, and with his life as a whole. It is a rare distinction to have a volume of a journal devoted to such a description of the life and labor of a scientist, and it is still rarer to have such a volume issued during life as a birthday surprise by his friends and fellow members in a scientific society. It speaks clearly of their admiration for him, not only as a scientist, but also as a man.

One of these friends has written of Professor Brigham in words so true that I cannot refrain from quoting them:

"In many ways he was not unlike the Apostle Paul. He embraced a great faith. He took missionary journeys, preaching the gospel of mature and sane geography. He wrote emphatic and attractive epistles—his books. The secret of Brigham's high success, as it seems to one who loved him, was that his philosophy of geography, exemplified in his own life and works, was essentially that of the great apostle of Christianity. He had faith in the soundness and fundamental importance of geography as he and his colleagues at home and abroad were developing it. He had hope that it would

live and grow. He had charity toward all the plans and ideals of all his fellow geographers of all ages and conditions, and he loved mankind. Without this triple gift Brigham could not have been the famous teacher that he was nor the well known author of whom we are proud; nor could he have played his rôle in the development of the Association of American Geographers and of the science of geography in the United States. He had a gift of speech and a genius of phraseology, and these he developed and utilized. Many men can speak eloquently and write persuasively and attractively; yet there are few Brighams."¹

There was one aspect of Professor Brigham's faith which I wish to note with especial appreciation. He believed that peace and good will would reign eventually among men. Particularly in his later years, when he saw tariff walls rising and quotas constricting international trade, with the world retrograding apparently toward the mercantilism of the Middle Ages, did he emphasize the importance of cultural contacts with the peoples of other nations. Maintain cultural contacts, instruct the peoples of your country about the peoples of other countries, and keep the faith in a better world, became his message. As he remarked in one of his last papers,

"If we keep some independence of action in this country, some slowness and some selfishness, remember that more than seventy-five million of our people have never been over the line; remember that ninety per cent of our native-born have never been abroad; remember that so many millions of our people are looking in on their grain fields and main streets, and only as far as their Fords and Chevrolets will carry them.

"It requires patience to wait, to work against odds. . . . We have got to be patient in the building of a nation."

It is the purpose of this memoir to commemorate the dead. But this act of commemoration is in itself a dead thing. Those of you who did not know the man whose memory we honor will not know him after hearing these feeble words, while those of you who did know him realize keenly how futile everything is which I have said. For those who did not know him, his death has no

¹Lawrence Martin, in the *Geographical Review*, July 1932, p. 450.

poignancy; and for those who did know him, commemoration is a silent and individual rite.

Let our purpose be, rather, to challenge to action. "Why should not a commemoration of the dead be an appeal to the living," a friend of mine has said who was himself dead a day later, "Not to deplore together, as if in an act of incantation, but to awaken our sense of responsibility to make the world less deplorable." Professor Brigham respected the English people and the British Commonwealth. He did much to interpret America to England and England to America. In a talk to the convention of the Young Women's Christian Association, at Sacramento, in 1928, he said,—

"I feel that our English heritage has had more to do with the unity of America than any other single factor, unless possibly the common experience. Even New England, with all its aliens; even New York City, with its cosmopolitan populations; even Wisconsin, with its foreign elements, some of them comparatively recent; even Minnesota; even California, with perhaps the most diverse racialism of any state in the Union; I believe every state is profoundly influenced by its English heritage, and the English language. Anybody in Great Britain, and in America, that can understand anything, can understand the English language, and one has said very well, where the English language is spoken, 'it is a message of freedom.'

"The English literature tells to us just as much as it tells to Oxford or Cambridge. English impulse has gone around the world. I mean that transplanted Britons take the initiative in this country—"Transplanted Britons forced to individualism and confronting vast opportunities.'

"Full flavoured nationality is 'the price of war,' said Zangwill; 'Nationality makes war,' said Brandes. There is a rational nationality, and an excessive nationality."

My friends, we are now infected, as is much of Europe, with a distrust and an antagonism that may lead to another war. For a decade our nation has pursued a policy which, in view of the debts of European countries to us, has resulted in draining them of their gold. To conserve their gold supply and preserve their farming people from catastrophe, they have raised tariffs, on farm products particularly, higher even than our own. Great

Britain was the last nation to depart from the principle of free trade, and did so only from necessity.

The direction of the drift in our relations with other nations, even with England, is the opposite of that which Professor Brigham, and every other person who has sought peace and prosperity among mankind would wish. Let us revere his memory by realizing the danger which he would have been the first to sense. Let us realize that the sincerest tribute to the dead consists in the silent promise that their work and their faith will not have been in vain. The truest commemoration will be the enlistment of our lives in the struggle between understanding and ignorance, good and evil, that continues in peace as in war.

The following titles supplement and complete the "Bibliography of Albert Perry Brigham" which appeared in this publication in June, 1930 (vol. 20, pp. 99-104).

1929.

An Appreciation of William Morris Davis, Founder of the Association.

Speech at the Anniversary Dinner of the 25th Annual Meeting of the
Asso. Am. Geog.

Annals Asso. Am. Geog., Vol. 19, 1929, pp. 61-62.

Excerpt in Geog. Rev., Vol. 19, 1929, p. 311.

1930.

Common Sense in Geography as a Social Study.

North Carolina Teacher, Vol. 6, 1930, pp. 380-382.

The Spirit of the Key in the American Turmoil.

Phi Beta Kappa Key, Vol. 7, 1930, pp. 559-564.

Why We are as We Are. Our Geography.

Geography, Vol. 15, 1930, pp. 563-571.

[*Speech at Centenary Dinner of the Royal Geographical Society.*]

Geog. Journ., Vol. 76, 1930, pp. 543-544.

1931

The Centenary of the Royal Geographical Society.

Geog. Rev., Vol. 21, 1931, pp. 142-145.

Geography for Children.

Address before National Council of Geography Teachers at Clark
University.

Jour. of Educ., Vol. 113, 1931, pp. 425-427.

Glacial Problems in Central New York.

Annals Asso. Am. Geog., Vol. 21, 1931, pp. 179-206.

Where Niagara Thunders.

Home Geog. Mo., Vol. 1, 1931, pp. 37-43.

Titles and Abstracts of Papers Washington, 1932

O. E. BAKER.

Agricultural Migration and the National Welfare. (Presidential Address. To be published in full in a later issue.)

ESTHER S. ANDERSON (Introduced by Nels A. Bengtson).

Geographic Factors in the Development of the American Sugar Beet Industry.

The geographic factors in the development of the American beet industry are (1) physical; (2) agricultural and industrial; and (3) economic.

Vaughn and Donaldson brought the sugar beet to America in 1830. First American sugar (1300 pounds) was manufactured in 1839 at Northampton, Massachusetts. Because of poor soils, unfavorable climate, inexperience of growers and inadequate manufacturing equipment, the industry failed in 1840. The Mormons attempted sugar manufacture shortly after 1847 because their geographical isolation demanded home industries. In 1855, the factory at Salt Lake City closed. Several unsuccessful attempts were made in Illinois, Wisconsin, New Jersey, California. E. H. Dyer, after several years of experimentation with beets, erected the first successful sugar factory at Alvarado, California. (1879.) The Morrill Bill (1883) and Sugar Bounty Act of 1890 (repealed in 1894) assured the young industry better economic conditions. Consequently, Claus Spreckles constructed a factory at Watsonville, California (1888). Here better cultural methods and favorable geographic conditions resulted in yields from 14 to 30 tons of beets per acre. With favorable results from many analyses of soils and beets, the Oxnard Brothers established the second successful sugar factory at Grand Island, Nebraska, in 1890. Rapid development followed the passage of the Dingley Bill (1897). The federal government began research to determine where most favorable geographic conditions for beet culture existed and to

develop better methods of cultivation. Experiments in the semi-arid and arid areas showed best results and 35 factories developed between 1896 and 1901. Then irrigation made possible by the Reclamation Act of 1902 opened new areas where climatic conditions (rainfall excepted) and soils proved excellent to sugar beet growth. Factories increased in the irrigated areas, and in 1915 seventy-nine factories operated. The World War caused another expansion, number of factories reaching 99. After the War, lower prices of beets and competition with large world supply of sugar caused a decline. An increase followed because prices for beets warranted better returns to farmers than other crops. In 1932, the estimated yield is more than 1,250,000 tons of sugar in America.

Summarizing, the beet industry in America first developed slowly, then rapidly and periodically, because (1) pioneers did not know the climatic and soil requirements of beets (now well established); (2) farmers' inexperience in beet culture resulted in low yields of beets and poor sugar content; (3) inadequate factory equipment. The periodic growth was due to passage and nonpassage of tariff and bounty acts or demand such as created by World War. Finally, the success of the industry in America is more dependent upon economic than upon physical factors. Large areas are geographically suited to expansion of beet growth but cost of production is so high that American sugar cannot compete with foreign sugar without tariff protection.

ROLLIN S. ATWOOD (Introduced by Wallace W. Atwood).

Home Life and Occupations of the Maya-Quiché Indians of the Chichicastenango Region of Guatemala.

(Presented by permission of the Carnegie Institution of Washington).

The highland is divided into three major natural regions, the young chain of volcanoes along the Pacific Coast, the maturely dissected Sierra Madre range, and the extensive plateau-like area made up of ash-filled basins ranging in elevation from 5,000 to 8,000 feet. The region chosen for detailed study is central in this plateau-like area, in the southern part of an ash-filled basin. It includes the village of Chichicastenango and surroundings in the Department of Quiché. This region is occupied at present by the Maya Quiché Indians who are believed to be direct descend-

ants of the ancient Mayans. The basin in which Chichicastenango is located covers approximately 1,000 square miles and attains an average elevation of 7,000 to 7,500 feet. The central part is level, gently rolling and only dissected by extremely young V-shaped canyons or barrancas. Bordering the basin is a maturely dissected terrace-like rim, also of volcanic ash, 800 to 1,000 feet above the level of the central area. At the outer edge of this rim is the contact with the granites, gneisses, and schists, and an abrupt rise to the mountain summits 3,000 to 4,000 feet above.

The population is concentrated in two physiographically distinct regions. One at the outer edge of the central area at the point of contact with the outer rim, the second region on the rim. The foundation of life is the growing of corn, wheat, and beans, done by the men. Each family owns a few hogs, turkeys, and chickens, cared for by the women and girls, and often a small flock of sheep or goats, tended by the young boys. These animals are kept on the agricultural lands belonging to members of the family and friends as long as possible, and only when there is no food left are they allowed to graze in the pasture or woodland areas. The lack of larger farm animals seems to be due to the fear the Indian has in investing so much money in one animal. Practically every Indian who doesn't work on fincas engages in commerce. A few of the less energetic carry their 75-90 pound loads of produce each week to the local market at Chichicastenango—for many a journey of three or four days over mountain trails. The majority buy and sell in practically every market in Guatemala, and even as far as Mexico City or San Salvador. Manufacturing is in the early handicraft stage and limited to products used by the Indians. Outside the village of Chichicastenango the tanning of skins, the spinning of blanket yarn, and the weaving of blankets are carried on by distinct families.

WALLACE W. ATWOOD.

The Highlands of Guatemala.

(Presented by permission of the Carnegie Institution of Washington).

The region inhabited by the ancient Mayan people 2,000 to 3,000 years ago is in the plateau area of western Guatemala with some adjoining lands in neighboring countries. The settled communities were located in great ash-filled basins. To the south-

west a chain of recently active volcanoes marks the margin of the upland. To the north and northeast an ancient mountain range rises conspicuously above the areas of volcanic dust. Fundamental to the geographic survey of that territory which has been begun under the auspices of the Carnegie Institution of Washington, is the division of the landscape into physiographic units and the interpretation of the physical history of the region.

WALLACE W. ATWOOD.

The Highways and Byways of Guatemala.

(Presented by permission of the Carnegie Institution of Washington).

The geographic survey of the region of the ancient Mayan communities will include a careful study of the modern life of that habitat and of its relationships to the geographic setting. The archeologists who are associated with the geographers recognize that the life of today among the modern Mayan people, inhabiting the highlands of Guatemala, will shed important light upon the adjustments to environment which must have taken place in the period 2,000 to 3,000 years ago when that land was inhabited by an ancient group of people of remarkable culture. As one wanders back and forth through this territory many of the sidelights are of interest and significance to the student of geography.

C. P. BARNES (Introduced by O. E. Baker).

Natural Land Use Areas of the United States.

This map (F. J. Marschner, co-author of map), presents a division of the United States into natural areas based on the characteristics of the land that influence, or seem likely to influence, its use. The uses of land primarily considered are the major rural surface uses, namely, crop farming, extensive grazing, and forest production, and the physical characteristics of land influencing them fall mainly into the three categories of climate, soil, and surface configuration. The influence of the physical attributes of land upon the minor uses of land in point of area occupied, such as residential uses, urban industrial uses, and upon sub-surface uses, were not specifically considered in delimiting the areas. The areas have been drawn so as to be as nearly uniform with respect to the characteristics of climate, soil, and surface configuration

influencing the use of the land, as is consistent with the necessity of making the areas sufficiently large to be useful in grouping counties and minor civil divisions into fairly homogeneous groups.

The object of this delimitation is to outline permanent and relatively uniform areas by which to segregate census data and study trends in land use over a period of years, to aid in areal sampling by making possible the selection of samples more adequately representative of the different kinds of natural "landscape," and to indicate areas throughout each of which it may be possible to apply a given land-use plan.

The map also presents a grouping of the individual areas according to the nature of their more important land-use problems, particularly their problems involving a question as to optimum use as between farming, extensive grazing, forest production, or combinations of these uses. Between the areas which are preëminently suited to agriculture on one hand, and those in which, because of aridity, or because of extreme ruggedness, crop production is impossible or very difficult, on the other, are many areas containing much land whose best use has not been thoroughly demonstrated. This is in some cases undeveloped land which needs drainage or clearing before it can be used for crops, and on which the desirability of undertaking such improvement in order to bring the lands into production is uncertain. In other cases it is land on which farming for one reason or another, has been marked by lack of success, by abandonment of farms, by rural poverty, or by destructive erosion. The map indicates those areas containing considerable amounts of land falling in these categories.

The sources of information used in constructing the map were:

1. Soil survey reports, federal and state.
2. Topographic maps of the U. S. Geological Survey.
3. Field notes of the U. S. General Land Office.
4. Land Classification maps of the Great Plains and Intermountain Region by the U. S. Geological Survey.
5. Summary of Climatological Data of the United States by sections by the U. S. Weather Bureau.
6. Miscellaneous sources, mostly secondary.

CLARENCE E. BATSCHELET (Introduced by Helen M. Strong).

Population Trends in Selected Urban Areas.

It is a recognized fact that the population growth in any fixed

area depends upon natural increase (excess of births over deaths), and migration. There is, however, a third factor which plays an important part in urban population development and which should be given serious consideration, namely, changes in a city's boundaries due to annexations or detachments of territory. The influence of annexations and detachments on the population growth is discussed for Philadelphia and New York, and reference is made to other cities where similar conditions have been found to exist. The facts indicate that the greater part of the growth of a city has occurred in the annexed area and that annexations during the past decade have played an important part in the individual city population development. Recognizing this fact, it is essential that more study be given to the population in the suburbs surrounding the cities, as the suburban territory of today will undoubtedly be the principal area of population development for the cities of tomorrow, unless modern means of transportation and new theories of city planning and development radically change the present trends.

NELS A. BENGTSÖN.

Distribution of the Native Peoples of Central America.

Broadly viewed, the native races of Central America may be classified into three major groups, namely: (1) those who appear to have entered from the north in comparatively recent historic times; (2) those who appear to have entered there early from the south; and (3) those living in the interior highlands of the present Honduras and Nicaragua whose origin is so uncertain that they are best represented as *residual tribes*. The area which is now included in the highlands of eastern Honduras and adjacent parts of Nicaragua has thus, from early times, been a meeting ground of races. Location is a geographic factor of primary importance in this instance. Natural features also played their part in guiding the racial streams to various sections of Central America. The lowlands on the north presented a continuation of the conditions found farther south, the direction from which it is believed that their earliest known inhabitants came. The lowlands on the south were a continuation of the environmental features prevailing northwestward and were peopled from that direction. The interior uplands with their continuations toward both north and south were peopled from both directions, literally a meeting ground of races. The central position of Honduras in middle

America was the dominant factor in making it the arena wherein met numerous tribes of diverse origins and characteristics, who were molded by landscape, climate, and racial heritage into groups varying in degree of social progress. Interior Honduras, with its mountains, valleys, plateaus, and plains, was abundantly equipped by nature with barriers to ready communication, and these served not only to guide distinct tribal movements, but also to develop strong tribal feelings under the primitive conditions then prevailing.

When Europeans came to this part of middle America they reached the center of a stage on which a great human drama was being played, albeit the climax for one set of actors had already passed. This drama has been modified and greatly guided by the features of the natural environment. Only a few of the most obvious relationships were comprehended, thus leaving to succeeding generations the task of untangling the braided threads of evidence. As yet many of the geographic problems are still unsolved. But now we know that when Columbus came, he found a land wherein human adjustments to terrain and climate had long been going on so that the land was "new" only in a European sense. The landscape which was to offer so many problems to the later arrivals had already impressed itself strongly upon the earlier ones. Out of it all, the new and the old, in Central America has arisen an intricate social complexity which is related directly and indirectly to the physical features of the environment.

H. H. BENNETT.

The Technique of the Quantitative Study of Erosion, and Some Early Results of this Study.

A statement briefly outlining the national program of soil erosion research, with respect to processes, rates of soil and water losses and methods of control, inaugurated in 1929 by the United States Department of Agriculture and cooperating states. The program is being carried out strictly along research lines, using the most important types of farm-crop soil in various regions where the problem is known to be very serious. Methods of technique are briefly outlined. Pertinent results are given showing soil and water losses under various treatments. These results have a basic relation to erosion processes, the cost of erosion in terms of soil and water wastage, by regions, and to practical methods of control.

W. O. BLANCHARD.

"Pearl Farming" in Japan.

One of the most interesting phases of Japan's thorough exploitation of her seas is the development of the "culture pearl" industry. Through the genius of one of her scientists, M. Mikimoto, the large factor of uncertainty in both quantity and quality of the world's output of pearls bids fair to be removed. His success promises to shift the production of these gems into the category of man-controlled operations whose output can be adjusted to suit market needs.

The requirements for the growth of the pearl oyster are rather exacting. The temperature of the water should be above 60° F., a drop below 50° F. being fatal. Clear, calm waters with a clean bottom, yet sufficient circulation to provide food and to remove wastes are necessary. One of the most important factors is reasonable freedom from the many enemies of the oyster, especially the octopus and star-fish, whose ravages are so destructive. However, given all of these conditions, left to themselves, only a small fraction of the oysters will actually produce pearls. Here, the interference of man is absolutely necessary and the success of the whole industry pivots about the work of the skillful "surgeons" who provide the irritant which stimulates pearl formation. After much investigation the culture pearl farms have been located, chiefly in several inlets of southern Japan. Even here, however, constant care is necessary throughout the whole 10-year span of life allotted the oysters. Thus the (1) floating oyster larva must be gathered and "spats" or young oysters reared artificially; the three-year-old spats must be operated upon and a "bead" introduced to serve as an irritant and nucleus for the pearl; the oysters must then be returned to the sea, but in metal cages to protect them from their enemies. The cages in turn are suspended from floating rafts which can be shifted about to avoid unwelcome currents. Lastly, the oysters must be removed and cleaned about twice a year to remove vegetation and dirt. Obviously a supply of cheap, skillful labor is an important factor. The ten "farms" now cover about 41,000 acres, employ about 1,000 people and yield about 600 pounds of pearls annually. The plantings have gradually increased, reaching in 1931, 6,300,000, of which 60% should bear pearls. The product first came on to the market after the World War and the output is increasing annually.

Protected by patents, fortified by long experience, and possess-

ing a group of carefully trained workers, the industry seems in little danger from outside competition even though there are probably many localities as favorably located through the tropic and subtropic seas. It is a case of the preponderant influence of the human, rather than the strictly physical, environmental factor.

J. F. BOGARDUS (Introduced by F. E. Williams).

North Brabant.

North Brabant developed much more slowly than the central provinces of the Netherlands. Water and bog isolated it from the other portion of the country, while the lack of good harbors limited its contacts with the sea. It was also handicapped by being largely covered with a poor, sandy soil. Thus until the latter part of the 19th century population was relatively sparse, and economic and cultural development retarded. During the last century the pressure of a rapidly expanding population made necessary the development of the more backward provinces. This movement caused North Brabant to increase rapidly in importance. The birth rate remained high, while the death rate fell. Thus population grew, large cities arose, and all forms of economic activity were intensified. Between 1850 and 1900 the construction of bridges and canals linked the province with other sections of the country, and laid the basis for economic expansion. Agriculture expanded rapidly, with a consequent reduction in the amount of waste land. Truck farming and gardening largely replaced the raising of grains and flax, while dairy cattle replaced sheep as the principal type of livestock. As a consequence North Brabant today ranks second among the Dutch provinces in butter production, and is important for its production of vegetables and small fruits. However, industrial expansion has been even more rapid. The wool and linen industries grew until the province leads the nation in the production of both of these commodities. It has also become the leading province in the production of shoes and electrical equipment. Numerous other industries developed. Thus today North Brabant is one of the most highly industrialized portions of the country, and the one with the greatest diversity of industrial life. This development of industry has provided employment for the rapidly expanding population, and has led to the sudden rise of cities. As population is continuing to increase, industries must continue to expand if the necessary employment is to be provided.

WILLIAM BOWIE.

Status of Geodetic Surveys in the United States.

Remarkable progress has been made in the extension of geodetic surveys over the United States during the past decade. In fact, during that time, nearly as much work has been done in this country as during the previous hundred years. The United States Coast and Geodetic Survey is charged by law with the extension of networks of triangulation and leveling over our area and with the making of a gravity survey of the country. The plan for the immediate future is to have arcs of first and second order triangulation and lines of first and second order leveling spaced at intervals of approximately 50 miles. These main arcs and lines will furnish the framework or basis for the detailed geodetic surveys, topographic maps, and for the location of political boundaries and for the boundaries of private property. The triangulation net of the country determines the positions of the coasts of the United States and, therefore, furnishes the basis for the hydrographic charts of the coastal waters.

The making of accurate charts and maps is a matter of great importance to geography. There are very few geographical matters not based on charting and mapping information. The data secured in the geodetic or control surveys are furnished to the engineers of the United States Geological Survey, which agency is charged by law with the making of the topographic maps of the country. There are now in existence in the United States about 35,000 miles of arcs of first and second order triangulation and approximately 75,000 miles of lines of first order and second order leveling. Adjustments have been made of the triangulation and leveling nets of the country so that the geographic position of the triangulation stations and the elevations of the bench marks will be held as standard or fixed in the future. There are now about 400 gravity stations in the gravity survey of the country and it is expected that many more stations will be added within the next year or two. The gravity data will be of value in many branches of physics and chemistry and in theoretical and economic geology.

W. H. BRADLEY (Introduced by F. E. Matthes).

The Course of the Green River Across the Uinta Range, Utah.

The Green River flows southward in Wyoming for many miles

on soft, nearly horizontal Eocene beds; then, without significant deflection enters the north flank of the Uinta Mountains which it crosses through a series of deep narrow canyons. Its course across this range bears no relation to either the structure of the rocks or the present topography. Heretofore the course of the Green River has been interpreted by some as an antecedent stream, and by others as a superimposed stream. Recent field work along the north flank of the Uinta Range has shown that two of the extensive erosion surfaces that played a significant part in the early history of the Green River are pediments and that, although a large part of the present course of the Green River was superimposed from the Late Tertiary Browns Park formation, that part of the course across the main range was established probably by stream piracy, aided by a partial collapse of the east end of the Uinta Range.

WILLIAM S. COOPER.

The Postglacial History of the Upper Mississippi River.

Rivers that come into intimate relations with an ice-sheet are foreordained to an eventful history; such a river is the Mississippi. The present study deals with the history of the river above Minneapolis since the recession of the Patrician ice-sheet of Middle Wisconsin time. After that event an intra-morainic drainage system came into being in which the Mississippi between Brainerd and Minneapolis occupied approximately its present position. The Grantsburg Sublobe of the Des Moines Lobe (Late Wisconsin), advancing northeastward between St. Cloud and Minneapolis, forced the river out of its course. Further, the Sublobe, making contact with the highlands in Wisconsin near St. Croix Falls, dammed the waters from the Des Moines and Superior Lobes, thus giving rise to a large proglacial lake in Minnesota and Wisconsin, here called the Grantsburg Lake. The portion lying in Wisconsin has been independently worked out by J. M. Hansell. During the disappearance of the Grantsburg Sublobe the Mississippi gradually shifted back approximately to its pre-Grantsburg position, during which process a broad pitted outwash plain was formed—the Anoka Sand Plain. After the Mississippi had been deprived of its glacial sources it cut an inner valley in the sand plain, which quickly extended itself upstream to Brainerd. This brought lowering of the water table in the adjoining outwash masses. The surface became desiccated, and extensive areas of dunes came into being. Sand movement continued until some time

after down-cutting had practically ceased, after which the dunes became stabilized. A postglacial period of climatic aridity may have been a contributory cause in dune formation. Comparison is made with European dunes of the same age.

STANLEY D. DODGE.

Population Regions of New England, with Special Reference to Areas of Decline: A Preliminary Study.

An examination of the distribution of areas of growth, decline, and stability of population in New England, on the basis of a comparison of curves of population numbers (against the familiar sine curve) reveals the existence of regions of contrasted development of population.

JOHN W. FREY.

A Few Notes on the Geography of the American Oil Industry.

Gasoline, the key commodity of the petroleum industry, is a great distance alleviator, and as such, a powerful factor in many geographical relationships. The distribution of automotive units is unequal and only one of the areas in which petroleum is produced is close to the major consuming areas. This has brought about a transportation system for crude oil and finished products with a resulting correlative freight structure, which, with a strong geographic basis, brings about a zone situation. Four zones are distinguishable.

Zone 1 (New England, Atlantic, and Gulf States) is subdivided into (a) an area (New England and the North Atlantic States) of heavy consumption with small production and large but insufficient refining, and (b) an area (Gulf Coast) of small consumption, very large production, and refinery capacity far in excess of local requirements. There results a heavy tanker movement from the Gulf area to the Atlantic Coast States north of Virginia.

Zone 2 (the Interior from the Appalachians to the Rockies) has three subdivisions: (a) the area east of the Mississippi River in which consumption is heavy, refining capacity large, but not quite sufficient, and production small; (b) the prairie states in which demand is small and production and refining non-existent, and (c) the Mid-Continent (Oklahoma, Kansas, Missouri, and North Texas) in which demand is very small, production very large, refining capacity large but insufficient to handle all the crude produced. The movement of crude and refined products from the

Mid-Continent area to the states east of the Mississippi results in the heaviest oil transportation in the world. Most of America's 100,000 miles of pipe line are in Zone 2, and tonnage by rail of manufactured petroleum products probably exceed those of any other manufacture except iron and steel.

Zone 3 (Rocky Mountain) is one of very small demand but one in which the scattered oil fields and the production of its numerous small refineries meet local requirements.

Zone 4 (Pacific Coast and contiguous states) is essentially California. Adjacent states consume California products but produce practically no crude petroleum. The position of California is isolated and its petroleum gets beyond the zone only in minor amounts through the Panama Canal to the North Atlantic and in exports. The Los Angeles area is a self-contained unit in production, refining, and consumption.

The location of oil refineries may be classified as follows: 1) In old oil fields (e.g. Appalachian) now operating largely for special products; 2) refineries in populous areas dependent largely on water-borne oil (e.g. New York-Philadelphia districts); 3) refineries located at tidewater between source of supply and markets (e.g. Texas and Louisiana gulf region); 4) refineries located in producing areas but at considerable distance from interior consuming areas (e.g. Oklahoma-Kansas). Special phase—skimming plants in fields of flush production; 5) refineries in areas that have outgrown locally produced supply and now dependent on transported crude by pipe line, (e.g. Indiana-Illinois); 6) the unique situation in the Los Angeles basin; 7) local units with respect to supply and demand (e.g. Montana and Wyoming); 8) combination of 2) with pipe line, (e.g. San Francisco).

W. H. HAAS.

Climate, Soils, and Sugar in Cuba.

Climate and soils in Cuba are not so ideally favorable for the growing of sugar cane as one might be led to believe from the reading of recent texts in geography. The natural conditions are, however, far more favorable than the slow evolution of the sugar industry, during Spanish control, would seem to indicate. Since independence, on the other hand, the development has been extraordinarily rapid, far more rapid than the natural advantages have warranted. As a result of this striking growth Cuba finds itself, at present, in an unusual plight. The product, for which the island is not only best prepared to produce but is in a large

measure also forced to produce, is now a glut on the market and cannot be placed there except at a definite loss. Is it possible for this "Gem of the Antilles," in the future, to prevent such a misdirection of energy and bring about a closer relationship between the welfare of the nation as a whole and the natural resources, so that the sugar industry will be more in harmony with natural advantages?

ROBERT BURNETT HALL.

Some Rural Settlement Forms in Japan, II.

The rural settlement forms of Hinokawa Plain, the Shirakawa Valley, and the Tokaido are analyzed and described. The limits of distribution of each type is determined.

The Hinokawa Plain is a steeply inclined and growing delta plain. Settlement follows the rapidly advancing shore line. Drainage and flood control present the chief agricultural problems. The habitation is adjusted to its amphibious site and to the strong winter monsoons. It bears certain Korean affiliations. Settlement in the Shirakawa Valley is limited to the several levels of narrow river terraces. The "giant" house is well developed. The control and utilization of small streams for irrigation, fish culture and water power are well advanced. The settlements along the ancient Tokaido, Japan's "Appian Way," bear definite relationships to the past commercial significance of the Tokaido. Each settlement has since been altered to fit the demands of the modern era.

WM. H. HOBBS.

Visibility and the Discovery of Polar Lands.

As a consequence of the glacial anticyclones on the borders of the continental glaciers, and in lesser degree about the smaller ice caps, outwardly directed air drainage brings warm air layers to over-ride colder ones. This inversion is responsible for the superior mirage which is so common a feature in such regions, and raises objects which are below the horizon into clear view. Combined with this phenomenon is an exceptional clarity of the atmosphere unequalled elsewhere. This is due both to the almost complete absence of both dust and water vapor. Examples are given where landmarks as much as two hundred miles distant have been clearly seen from airplanes, and where aided by mirage nearly as far from the deck of a vessel.

Under such conditions landmarks may be much farther away than estimated and therefore incorrectly mapped. Thus it has come about that later explorers have sometimes sailed over charted lands and so done great injustice to earlier navigators. With a shift in the winds the exceptional atmospheric clarity may vanish as if by magic.

PRESTON E. JAMES.

Rio de Janeiro; A Study in Tropical Urban Geography.

This paper deals only with that aspect of an urban study which covers the development of the urban scene on a particular site. This development, in the case of Rio de Janeiro, has been carried on in a typical Portuguese manner. Until recently the growth has been entirely unplanned. Details of the city pattern represent adjustments to minor elements of the setting which have since in many cases been obliterated. Most of the main avenues, to which the details of the city have been articulated, were established during the 16th and 17th centuries. These avenues turn aside to avoid swamps or hills now filled or razed. Similarly most of the present superior residence areas are located in areas utilized during the 17th century for sugar estates. The orientation of the commercial core has been radically changed during the present century by the cutting of the broad Avenida Rio Branco through the heart of the old city. By the building of a new water-front with new buildings and tree-lined parkways, a veneer of spectacular beauty has been applied to the old city which lies a few blocks inland. A most remarkable and unique city pattern is the result.

MARK JEFFERSON.

Communications and Civilization.

Communications are regarded as involving the most effective of man's tools that have fostered his growth in civilization. Reasons are given for the belief.

The statistical data available for studying modern communications—date 1925—appear to be (1) the miles of railway in a country for each thousand square miles of occupied territory, (2) the number of pieces of mail handled per capita, (3) the number of automobiles for each thousand inhabitants and (4) the number of telephone instruments in use per thousand people. The data are studied on the world map, indices formed from them and a combined index including them all. Attention is paid not merely

to the distribution of the data about the world but also to their changes through recent years.

LESTER E. KLIMM (Introduced by Frank E. Williams).

The Relation between Topography, Land Values, and Recent Immigration in Western Massachusetts.

It is commonly supposed that the "new" immigration does not go into agriculture or into rural areas. In a recent census study one of the writers made the observation that this was probably due more to lack of opportunities for obtaining cheap land than to lack of interest in agriculture. He indicated that perhaps the East with declining prices for poorer farm land would see a revival of the entrance of immigrants into agriculture. In Hampden, Hampshire and Franklin Counties, Massachusetts, there is a great deal of cheap land available in the hilly townships. These are the regions of "abandonment." Population is declining, land in farms is declining, but the number and percentage of recent immigrants are increasing. This would seem to indicate that cheap land, even if it is poor, is still attractive to the immigrant.

A. K. LOBECK.

The Geography of the Transcontinental Air Route.

The air route from New York to San Francisco via Cleveland, Chicago, Omaha, Cheyenne, and Salt Lake City touches eleven of the seventeen major physiographic provinces of the United States. Almost every type of landscape feature may be seen along the way, some more perfectly represented than anywhere else in the world. For example, the zig-zag ridges and pitching folds of the Newer Appalachians and the block mountains of the Great Basin with their recent fault scarps and old lake terraces are objects of striking interest. The air traveller has impressed upon him too, at every stage of the journey, some exceptionally interesting geographical phenomena, unusually impressive because of the continuity of the panorama. The variations in agricultural methods from place to place demand constant explanation and these constitute always a dominant note in the landscape. Of especial concern to the man in the air is the weather and to some extent the climate of the region through which he is passing. The purpose of the paper is to set forth some of the advantages and perhaps also some of the handicaps to studying geography in this manner.

A. K. LOBECK.

Three Devices for Teaching Astronomical and Mathematical Geography.

The Students' Astrolabe, readily constructed by students from ordinary hardware and light wood of standard size, is designed after the manner of a real telescope with equatorial mounting, but without the use of lenses. With it stars and planets can be identified from their true astronomical positions. It is, however, extremely simple and readily understood by secondary school children.

The Students' Alidade, also readily made by students from standard hardware and light lumber, is based upon the regular alidade and plane table used for topographic mapping. It has no lenses, however. Distances up to 400 feet can be read by means of cross-wires, and differences in elevation can be measured by angles and by the Beaman Arc. With it students can be taught how to make topographic maps and run traverses and level lines in a truly scientific manner.

The Stellolocator is more elaborate than the other instruments described and can not readily be made by the students themselves. It has no lenses, however. Stars are observed by accurately directing a pointer toward them. An indicator then shows automatically on a large Star Chart the location and name of the star. It is slightly less instructive than the Astrolabe but would appeal to those who wish to find the names of the stars but have no interest in nor ability to understand the mathematical aspects of the subject.

FRANÇOIS E. MATTHES.

The Committee on Glaciers of the American Geophysical Union, and Its Work.

One of the first committees to be organized by the Section of Hydrology of the American Geophysical Union, after its first annual meeting in May, 1931, was a Committee on the Hydrology of Glaciers (since known as the Committee on Glaciers). The principal duties of this Committee are to obtain and interpret records of the advance and retreat of the glaciers in the continental United States and Alaska. It is concerned also with related records of the movement of the ice in glaciers, with weather conditions affecting the regimen of glaciers, and the discharge of water from glaciers. Its functions, therefore, correspond in the main to those of the *Commission des Glaciers* in Europe, which

was created in 1927 by the Section of Scientific Hydrology of the International Geodetic and Geophysical Union. With this international commission the American Committee on Glaciers is affiliated.

Since its organization the Committee has actively set about to gather whatever data may be available on the variations which the American glaciers have suffered in the recent past; it has laid the foundation for a catalogued collection of glacier photographs; and it has taken steps to enlist the coöperation of various organizations and individuals in making annual measurements and in securing annually photographs and other data of specified glaciers in this country and Alaska. The work that has been accomplished along each of these lines is described briefly in this paper.

RAYMOND E. MURPHY (Introduced by Glenn T. Trewartha).

The Geography of Johnstown, Pennsylvania: An Iron and Steel Center.

The surface of the Allegheny Plateau east of Pittsburgh is etched by the deep valleys of the Conemaugh River and its tributaries. At the confluence of the two major tributaries a limited area of terrace land occurs in the valley bottoms. Occupying this terrace land, and, in a few places, extending on to the Plateau surface above, is the city of Johnstown, Pennsylvania. Dominance of an iron and steel industry, the numerous bituminous coal mines in and about the city, the stream junction site, the way in which the city is strung out along valley bottoms—all these make particularly apt the designation of Johnstown as a "Little Pittsburgh."

The history of Johnstown is a record of changing adjustments to a static environment. Neither the Indians whose villages first occupied the site nor the founders of Johnstown who came later were concerned with the iron ore in the adjacent hills or the seams of bituminous coal through which the streams had cut their valleys; but while flat-boat trade on the Conemaugh, and, later, trade over the Pennsylvania Canal and the Portage Railroad were holding the center of the stage the iron and steel industry was making its humble beginning. Small forges using bog iron ore were followed, about the middle of the nineteenth century, by an organized industry based upon iron ore mined at Johnstown. The charcoal which was used in this early industry gave way fifteen or twenty years later to coke, and, with the rise of steel, Lake Superior ores

replaced the local product in the industry's blast furnaces. As the steel industry grew so did the city, until today Johnstown and its adjacent boroughs have an aggregate population of about 100,000.

Blast furnaces, steel mills, and other forms of the iron and steel industry are critical features of the landscape of the present city. Less noticeable, but at least equally critical, are the construction forms which mark the mouths of the shafts and drifts from which coal is obtained for local use and for shipment. Even more striking than these modern adjustments to mineral resources is the close relationship to topography which has characterized the city from the beginning of its history.

ROBT. S. PLATT.

Mining Patterns of Occupancy in Five South American Districts.

This study based on reconnaissance field work in contrasted mining districts illustrates a non-regional standardization of mining technique emanating from Europe and North America, together with a distributive individuality of mining patterns functioning areally in ways befitting their several sites and regions.

The Bolivian tin mine fits into its site at an outcrop of narrow veins on a mountainside 15,000 feet above the sea in an isolated highland region where life resources are meager but have allowed sustenance farming communities to exist. The Brazilian gold mine extends downward to a great depth in a persistent low grade vein deposit outcropping in a rolling subtropical plateau rich in resources, inhabited by a moderately dense rural population, and readily accessible from the outside world. The Chilean copper mine penetrates a massive volcanic structure, and its external parts are perched on precipitous slopes and scattered down the course of a mountain canyon, bleak and bare in itself but opening into a fertile populous central valley. The Chilean nitrate plant is on a mineralized bed lying horizontally in a nearly flat extremely desert valley plain back of a coast range. The Peruvian oil field taps productive beds in sedimentary rocks of a desert plain immediately adjacent to the coast, the wells and associated establishments being distributed widely and regularly within an irregular, well defined area.

In every case the control, the management, the methods, and the equipment are European or North American but in every one the functional pattern of terrene occupancy is distinctive.

SIDMAN P. POOLE (Introduced by H. H. Barrows).

Oyster Culture in the Auray River of Brittany.

Jutting into the southwest coast of ancient Brittany is the Gulf of Morbihan. A sinking of the coast since Pleistocene time has enabled the sea to penetrate into the land and drown the lower valleys of the streams which had carved out depressions in the softer bands of rocks. The Rivière d'Auray is the only one of these that had developed much of a valley on the old peneplain and thus produced an estuary or aber of sufficient size for the present day site of the oyster industry.

There are six points in France where oyster culture is concentrated and only two of these—Arcachon and here in the Morbihan—engage in the breeding of the naissin (young oysters). For this a peculiar complex of ecological conditions is required; protection from high waves, strong tides, bottoms of mixed mud and sand, freedom from fresh water, and temperatures of at least 17° C. The flats where the breeding barrages are to be built must be adjacent to but not in the tidal channels and up stream from a natural bank which is the source of the young oysters.

The technic of the industry shows a progressive adaptation of means to an end. Towards the end of June the female oyster emits a cloud-like mass of millions of tiny young which is drifted to and fro by the tides. Semi-cylindrical tiles, coated in lime, have to be placed on the beds at this time. If placed too soon, they become coated with mud and the oyster settles only on hard, clean and white surfaces. These tile collectors are placed on rows of stakes and protected from various marine enemies by banks of mud and stone. The bottoms of the barrages, chosen for their flatness, mud-sand flooring, position near to tidal channels and at just about mean tide level, have to be carefully prepared for the industry. This is highly seasonal, there being two labor peaks; the one at spawning time (June-July) and the other at the chief shipping season (February-March). These short periods integrate well in time with the other maritime and agricultural activities of the Morbihan littoral and thus insure a cheap, abundant labor supply.

The natural beds, having suffered from a severe plague in 1921-22, are no longer an important source of edible oysters. Severe government restrictions are rigidly enforced against dragging and all the operations of the breeding are closely supervised in the interests of the public health.

Taken altogether here is a rather unique example of an industry, the technic and development of which is in close harmony with its peculiar environmental complex.

EDWARD C. PROPHET (Introduced by K. C. McMurry).

A Survey of the Recreational Industry in Michigan.

Gogebic County, the westernmost one in the Upper Peninsula of Michigan, is used as an example of this survey and inventory. It contains in the southeast a large number of irregular shaped lakes due to the derangement of the drainage by glaciation, Lake Gogebic, a large lake, near the center of the northern boundary, and borders Lake Superior on the northwest. Originally almost the entire county was covered with a fine forest of maple and beech on the uplands and swamp conifers on the poorly drained sections. About three-fifths of the virgin forest has been cut and it has been replaced by cut-over, burned-over tracts, thickets of poplar, or in a few cases, good quality second growth timber.

The recreational industry has developed along three lines; namely, hunting and fishing, summer homes or cottages, and caring for tourists. Hunting and fishing is practiced generally throughout the entire county, especially in the southeastern part. Resort developments are centered at Little Girls Point on Lake Superior with eleven cottages, at the southern end of Lake Gogebic with twenty-one cottages, and in the southeastern lake district with sixty-six cottages. The resort development is small and is intensified in just a few places. It can expand greatly without any crowding. All tourists visiting the western part of the Upper Peninsula must go through this county. From July 1, 1930 to June 30, 1931, over one hundred thirty thousand out-of-state automobiles passed through Ironwood, the largest city of this county and also the westernmost entrance to the state of Michigan. At the present time, the main activity of the recreational industry is the caring for the needs of these tourists.

The primary objectives of the survey were of economic rather than geographic interest. This paper is limited to the geographic phases of the recreational industry.

EARL B. SHAW (Introduced by Clarence F. Jones).

St. Croix, a Marginal Sugar Producing Land.

St. Croix, one of the United States Virgin Islands, is a marginal sugar producing land. Sugar raising is handicapped by

insufficient and poorly distributed precipitation, excessive evaporation and tropical hurricanes; and it is deprived of supplementary moisture supply through irrigation because of unfavorable geologic structure. The producing area is limited to the small Tertiary coastal plain by maturely dissected uplands on the northwest and east. After the sugar is manufactured, poor harbors make lightering necessary and add to the cost of export. Finally, economic drawbacks, which include labor difficulties, prohibition, and small size of centrals, impair the industry's productive efficiency.

In times of high prices these obstacles are critical, but the island makes money together with the world's low cost production areas. In periods of depression the limiting geographic environment makes profits impossible. Whether sugar will continue to dominate St. Croix's exports as it has for over two centuries will depend upon future price trends. If markets remain low, cane fields will revert to pasture; but if prices rise sufficiently to allow a profit for marginal sugar raisers, production may expand in spite of unfavorable physical and economic factors.

EUGENE VAN CLEEF.

The Finns on Cape Cod and the Problem of Adjustment to the Natural Environment.

The presence of the Finns on Cape Cod is consistent with their mode of settlement elsewhere. Sensitivity to a natural environment which is similar to that of their native land is pronounced. However, the settlement in the same general area of another nationality ethnically different, namely, the Portuguese, presents a challenge to the theory treating with the part played by geographic conditions in the adjustment of a particular people to a particular environment. Does the evidence demand that we abandon our theory of human adjustment to the natural environment or shall the evidence be interpreted as an exception to the rule?

R. H. WHITBECK.

The Lesser Antilles—Past and Present. (Published in full in this issue.)

DERWENT WHITTLESEY.

Andorra's Autonomy.

The geographical roots of the exotic political plant known as Andorra seem not to have been sought. Isolation, the independent

spirit of mountaineers, and the mutual jealousy of France and Spain, have been cited in explanation of Andorra's autonomy. None of these adequately accounts for the political status of the district, which is that of a feudal fief with two suzerains exercising power conjointly.

Andorra, in the high valley of the Valira, owns summer pasturage in excess of its ability to provide winter feed; hence it has intimate economic relations and consequent social and political contacts with its nearest neighbors, the people of the valley of the Ariège on the north, and the people of the Cerdagne (valley of the Segre) on the south. The passway formed by these valleys makes the only moderately easy route through the Pyrenees between the Col du Perthus and the Somport. Moreover the upper end of the Cerdagne leads by another pass into the valley of the Tet and so to the plain of Roussillon. The struggle to control this strategic "Y" of routes was waged by the counts of Foix (Ariège) and the Prince-Bishops of Urgell (Cerdagne). Andorra was a useful pawn in the struggle, for through it lies a back way from Foix to Urgell, difficult, but passable in summer. To end years of devastating warfare, the two evenly-matched rulers in 1278 signed an *Acte de Paréage*, which established them as joint suzerains of Andorra and certain other disputed territory. As feudalism gave way to national states, the territories of Urgell and Foix were merged with larger units and ultimately with Spain and France respectively. Their relative strength remained near parity, but Andorra became less significant with increase in power of the adjacent states. Adjacent to both France and Spain, but cut off physically by the Pyrenean watershed from the more powerful of these neighbors, and not worth a war to either, it has retained its autonomy, natural in feudal times, anomalous in a world of national states. On the occasions when its status has been threatened by one suzerain, it has been able to redress the balance by legal appeal to the other. Beginning about a score of years ago, the penetration of motor roads into Andorra from both France and Spain, and the building of hotels at hot springs in the heart of the district, have culminated this year in construction of the final road-link. In 1933 it will be possible to traverse Andorra from France to Spain or vice versa. Thus isolation ends and value begins. The effect on political status of this change in situation and resources relative to the world at large will throw some light on the validity of the hypotheses of Andorra's autonomy, as set forth in this paper.

ELLA M. WILSON (Introduced by Mark Jefferson).

National Population Figures Reduced to Standard Dates.

Geographers cannot prorate data to populations without having tables of population at precisely stated standard dates for the purposes of comparison and interpolation of values between census dates.

Official data are not merely taken in different years but on different months and days within the years. Thus the latest census figures of population for ten countries are:

Country	Population	Date of Census
United States	122,775,046	April 1, 1930
United Kingdom	46,189,445	June 19, 1931
France	40,743,897	March 7, 1926
Germany	63,180,619	June 16, 1925
Soviet Republic	147,013,600	Dec. 17, 1926
Italy	40,796,000	Jan. 1, 1928
Poland	30,213,000	Jan. 1, 1928
Switzerland	4,067,394	Dec. 1, 1930
Sweden	6,124,080	Dec. 31, 1929
Norway	2,809,564	Dec. 1, 1930

We make the assumption that each of these figures is true *for the close of the day indicated*. We wish to reduce them to the probable values for the beginning and middle of each decade, 1925.000 and 1930.000, which refer to the midnight following Dec. 31, 1924 and 1929.

The United States Census was taken 1930.24875 and the figure is only true for that date. The population for 1930.000 is needed and appears to have been 122,355,263 with an annual increment of 1,664,464. The paper supplies these reductions for a number of countries.

Exhibits at the Washington Meeting

Those who attended the Washington meeting of the A. A. G. were given a chance to see what a remarkable museum and laboratory of geography our national capitol has become. The twenty-two members of the Association who work in the various societies and government bureaus held open house where they and their colleagues revealed vistas of the numerous and significant contributions to geography which they are making. The exhibits were varied: there were special displays of recent output, interesting samples of grist currently passing through geographic mills, and personally guided tours through workrooms and libraries where geographic materials are being studied, assembled, interpreted, and prepared for distribution.

The following alphabetical list may serve to recall to those present and to suggest to others the wide scope of the exhibits:

At the Library of Congress, the Division of Maps was thrown open to inspection; on view were rare old maps and atlases, and newer ones which held special interest. The housing and arrangements for using this large collection of maps of all sizes are especially instructive.

The new laboratories and exhibition rooms of the National Geographic Society, opened a few months ago, were shown by members of the staff. These incorporate the experience of many years in carrying photographs through all the stages from the moment the films leave the camera until the reproductions in black-and-white and in color appear in the well-known publication of the Society. The vast collection of photographs which the Society has amassed, as well as its library and the offices of the staff, were likewise shown to visitors.

Geographic work of the United States Department of Agriculture is divided among three bureaus. The Bureau of Agricultural Economics prepared a special display of maps and studies on land utilization. The Soil Survey exhibited colored photographs of soil sections, and diagrams showing soil erosion. Unpublished soil maps prepared for the Atlas of American Agriculture were likewise on view. The Weather Bureau is itself a perpetual scientific exhibit and a continuous-process laboratory.

By coincidence the geographic work of the United States Department of Commerce is also divided among three bureaus. The new building of the Department itself merits a visit. Members of the Bureau of the Census and the Bureau of Foreign and Domestic Commerce were on hand to discuss their current projects, which lend themselves less readily than some of the others to graphic or mechanical display. At the Coast and Geodetic Survey recent output was to be seen.

The Geological Survey of the United States Department of the Interior showed maps of areas where their efforts have been recently directed. Several of these were specially prepared to supplement work in hand by other government bureaus. The coöperative integration of the several federal services contributing to geography is a testimony to their usefulness. The Survey also displayed an instructive series of maps, stones, and metal plates, showing the several processes by which are produced the topographic and other maps issued by the service.

In the United States Department of State were to be seen maps which have been the official bases for demarking boundaries of the United States, examples of maps which are integral parts of treaties, and work which is being done by the Office of the Geographer to provide data for impending boundary settlements and to preclude, if possible, future disputes.

